International Journal of Applied and Natural Sciences (IJANS)
ISSN (P): 2319–4014; ISSN (E): 2319–4022
Vol. 10, Issue 2, Jul–Dec 2021; 85–92

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

DIURNAL OXYGEN VARIATIONS AND OXYGEN CONSUMPTION OF *PENAEUS MONODON* WITH COMPARISON OF TEMPERATURE, PH AND TURBIDITY IN CULTURE POND

K. Rama Rao[1] & D. E. Babu[2]

[1]*Department of Zoology, Dr. V. S. Krishna Government Degree College (A), Visakhapatnam, Andhra Pradesh, India*

[2]*Science & Technology, Department of Zoology, Andhra University, Visakhapatnam, Andhra Pradesh, India*

ABSTRACT

Dissolved oxygen levels and variations have been monitored in culture pond stocked with P. monodon. Experiments were conducted on diurnal variations of oxygen consumption, temperature, pH, turbidity, growth and biomass. In the experimental culture pond the lowest oxygen was recorded in early morning is 2.08±0.183mg/lit and night (12 AM) is 4.73±0.295mg/lit at 124 to 128 days of culture period. The lowest water temperature was recorded in early morning is 19.7^{0}C and evening (6PM) is 23.5^{0}C at 130 days culture period. The lowest pH was recorded in early morning is 7.4 and evening 7.6 at 124 to 128 days. The lowest transparency/turbidity was recorded in early morning is 37.5 cm, and evening is 25.5 cms. The Pearson Correlation Coefficient of individual body weight and total biomass of R value is +1. This is a strong positive correlation, which means that high X variable scores go with high Y variable scores. The P-Value is <.00001hence the result is significant at p <.05. The F value of temperature, pH and turbidity is a value on the F distribution to determine the test is statistically significant in culture ponds.

KEYWORDS: *Pearson Correlation Coefficient, Oxygen Consumption, Temperature, pH, Turbidity, Culture Pond, Estuary*

Article History

Received: ***21 Oct 2021*** **|** ***Revised:*** ***25 Oct 2021*** **|** ***Accepted:*** ***28 Oct 2021***

INTRODUCTION

Penaeus monodon is a brackish water shrimp, widely distributed and cultured throughout the coastal areas of India. This is highly relished in different countries as a food organism due to its nutritive value. Considering the very fact that these tolerate wide range of salinities (euryhaline) 0-50 ppt, and wide range of temperatures 15°-35°C, this species has been chosen as a candidate species for brackish water aquaculture and this has dominated all other brackish water cultivable finfish and shellfish species in India. *P. monodon* usually referred to as the tiger prawn, has a definite life-cycle, the adults reproduce in high saline waters of the sea and the post-larva (juveniles) migrate to the estuaries and brackish water areas and grow to the sub-adults, the sub-adults once again migrate to the sea for further growth and breeding. The larval forms usually require high salinities and they are plankton feeders. The post-larvae feed both on plankton and deposited organic food material. The feeding behaviour is mainly dependent upon habitat and the mouthparts also develop in such a way utilize the maximum food resources available.

A large number of entrepreneurs have already taken up mass culture of this species in grown out ponds. Taking into consideration of this particular point, the present research work is planned to work out the details of growth and the dissolved oxygen requirements of *Penaeus monodon*. The dissolved oxygen plays a very significant role in aquaculture of shrimps, influencing on the phenomenon of moulting and growth. Moulting and growth are intimately associated phenomenon and the duration of a moult cycle is directly dependent upon the dissolved oxygen levels. Low oxygen tensions leads to extension of the moult cycle, and mortality of shrimps. This is true in laboratory cultured shrimps, and also under pond environment. The requirement for dissolved oxygen varies and depends upon the age of the shrimp and stage of the moult cycle. Greater quantities of oxygen is required during the, pre-moult and post-moult periods, in association with greater metabolic rate. The dissolved oxygen levels of the pond are dependent upon the season, length of the day, climatic conditions and biotic and abiotic factors., When the shrimps have crossed 30 gms body weight they moult once in every 15 days i.e. once during the full moon day and once during the no moon day.

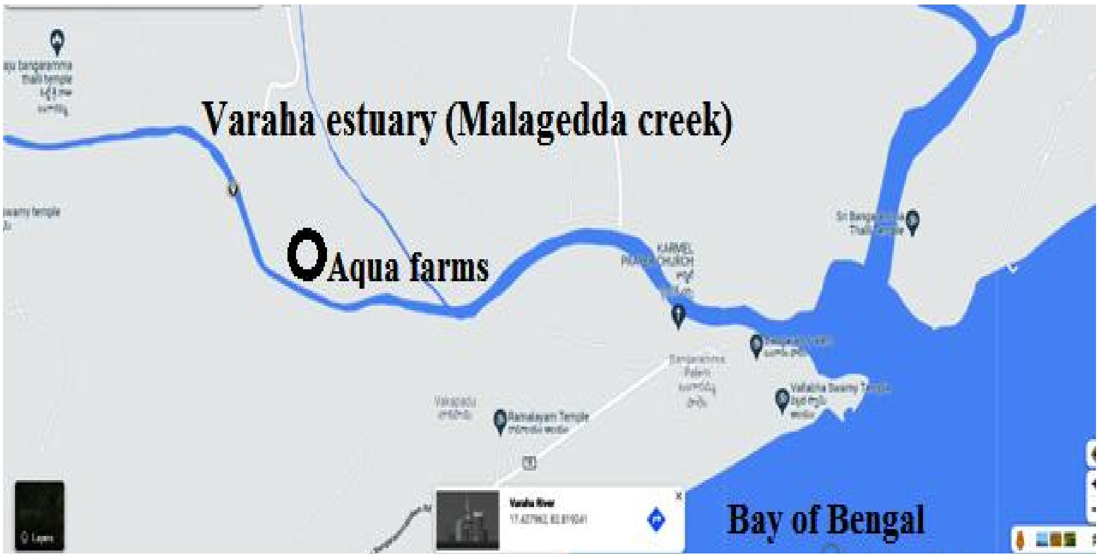


Figure 1

METHODS AND MATERIALS

Experimental studies on growth of shrimps under pond environment, the shrimp culture ponds of Varaha Aqua Forms, Sarvasiddi, near S. Rayavaram, Visakhapatnam district, Andhra Pradesh were taken and monitored regularly for 150 days during the study period from April 10th to Aug 17th. One pond was chosen and feed and water management was totally taken up and were maintained as given in the results. Water was drawn from Malagedda creek of Varaha estuary (Figure 1). A constant water depth of 5 feet was maintained by careful adjustment of wooden planks at the outlets, flow-through system of water exchange was always maintained. Every alternate day about 5-10% of the water was exchanged by pumping fresh creek water into the ponds.

The shrimps were fed four times a day at an interval of 6 hours, at 5 AM, 11 AM, 5 PM and 11 PM. The feed given was the commercial shrimps feed (Nova) supplied by C.P. Group of Company, Thailand. For these studies, juveniles of Penaeus monodon were initially stocked in a nursery pond at post larval- 20 stages. When the juveniles have grown to a size of 1 gram, then these were shifted to the culture pond of the size 800 m2 water spread area. A stocking density of 4 shrimps/m2 was usually maintained the experimental ponds. Water turbidity / transparency was estimated by using a secchi disc. Water depth was measured by using a wooden scale. pH and temperatures were regularly monitored at 6 AM in the

morning and 6 PM in the evening. Dissolved oxygen was estimated 4 times a day by collecting water samples both from the surface layers and also from the bottom by Winkler's titrimetric method Montgomery et al (1964). The results given in the tables are the averages of surface and bottom values. Weight changes were monitored regularly for every four days by collecting the shrimps by cast netting. The total biomass was calculated by multiplying the number of shrimps with weight. Which are tabulated the data on Pearson Correlation Coefficient of individual body weight and total biomass of R value. One-Way ANOVA Calculator for summary of data to the value of f and p.

RESULTS

Dissolved oxygen levels and variations have been monitored in culture pond stocked with *P. monodon*. The dissolved oxygen levels have been estimated from juvenile stage (about 20 mg size) onwards up to the adult stage, weighing 40-42 gms. In the culture pond studied, greater oxygen levels were observed from 2 PM to 6 PM (6.93±0.234), and afterwards a gradual decline in the dissolved oxygen levels was noticed. Minimum levels of dissolved oxygen were noticed at 5 to 6 AM (3.86±0.231). The dissolved oxygen levels were directly dependent upon the age and size of the shrimp. During the early days of stocking of the juveniles, dissolved oxygen levels were maintained both during the night time and day time without much fall in its concentration during night time, but with an increase in biomass of the pond, which is related to an increase in the size of the shrimp, the dissolved oxygen levels were not maintained constant and differences were more between the day time and night time. The dissolved oxygen levels were 4.73±0.295 ml/lit during the day time and values fell 2.08±0.183 ml/lit during early hours of the day before sunrise (Table 1).

The transparency/turbidity as a measure of phytoplankton bloom has been monitored throughout the culture period. During the day time, the turbidity gradually increased along with an increase in day time temperature and radiation. Maximum transparency was observed at about 6 AM, when there was no Sunlight. Turbidity was more during the afternoon and evening times. The concentration of dissolved oxygen is directly related to the phytoplankton bloom, vis-a-vis transparency/turbidity. The dissolved oxygen levels were increased gradually during the day time in association with photosynthetic activity of the phytoplankton. After sunset the transparency once again increased gradually with maximum levels during the early hours. During the cloudy day and rainy day the planktonic bloom was not seen and this resulted in a decrease in the day time dissolved oxygen levels (Table 1).

The Pearson Correlation Coefficient of individual body weight and total biomass of R value is +1. This is a strong positive correlation, which means that high X variable scores go with high Y variable scores. The P-Value is <.00001hence the result is significant at $p < .05$ (Table 2, Figure 2). The F value of temperature, pH and turbidity is a value on the F distribution and it is statistical tests generate an F value. The value is determined whether the test is statistically significant in culture ponds (Figure 3).

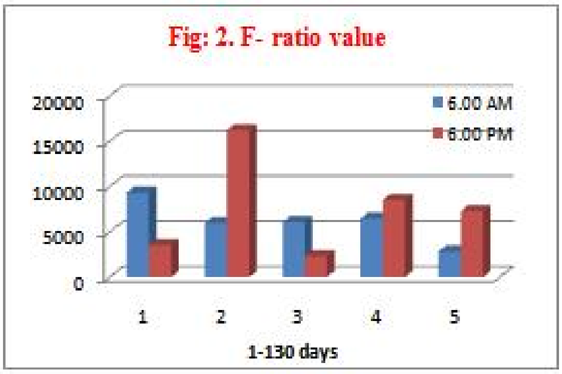
Table 1: Diurnal and Nocturnal Variations in Dissolved Oxygen, Temperature, pH, and Transparency/Turbidity in *Penaeus Monodon* Culture Pond on April 10th To Aug 17th

Day	Dissolved Oxygen, ml/lit.				Body Weight	Biomass Kg.	Temperature 0^{C}			pH		Transperency / Turbidity. cms	
	6 AM	12 N	6 PM	12 PM			5AM	2PM	6PM	6 AM	5 PM	6 AM	5 PM
1	3.86±0.231	5.97±0.220,	6.93±0.234	5.92± 0.257			27.5	30.6	31.8	7.8	8.0	37	29.5
2	3.84±0.299	5.95±0.278	6.91±0.101	5.90±0.231			27.7	30.5	31.5	7.8	8.1	37	28
3	3.84±0.250	5.95±0.187	6.91±0.150	5.89±0.131			27.5	30.4	31.4	7.7	7.9	36.5	28
4	3.83±0.254	5.93±0.231	6.90±0.141	5.87±0.231			27.2	30.5	32.2	7.7	7.9	36.5	28.5
5	3.82±0.275	5.92±0.257	6.90±0.186	5.85±0.254			27.4	29.6	31.7	7.7	8.0	36	27
6	3.78±0.214	3.93±0.231	6.89±0.164	5.84±0.275			27.7	29.8	31.5	7.5	7.8	35	27
7	3.75±0.282	5.90±0.231	6.91±0.150	5.83±0.376			27.5	30.2	31.5	7.5	7.7	34.5	27
8	3.72±0.250	5.89±0.231	6.89±0.151	5.92±0.275			27.4	29.8	31.7	7.5	7.7	36	28
9	3.68±0.230	5.87±0.231	6.90±0.186	5.89±0.231			27.3	29.6	31.8	7.5	7.8	36	27.5
10	3.67±0.254	5.90±0.231	6.91±0.156	5.85±0.254			27.2	29.5	31.5	7.4	7.6	35.5	26
11	3.76±0.413	5.92±0.252	6.89±0.164	5.83±0.376			27.4	29.7	31.8	7.4	7.7	37	25.5
12	3.72±0.250	5.95±0.275	6.90±0.186	5.84±0.275			27.2	29.5	31.6	7.4	7.6	37	26.5
13	3.68±0.320	5.93±0.231	6.90±0.186	5.80±0.262			27.4	29.8	31.8	8.5	8.7	36	27.5
14	3.67±0.254	5.92±0.257	6.89±0.164	5.80±0.262			27.5	29.9	31.9	8.5	8.8	34	26
15	3.56±0.437	5.90±0.231	6.89±0.151	5.78±0.275			27.3	29.4	31.1	8.6	8.6	33.4	26
16	3.54±0.319	5.89±0.231	6.85±0.186	5.77±0.308			27.1	29.3	31.5	8.5	8.5	33	25.5
17	3.51±0.369	5.89±0.254	6.84±0.165	5.78±0.320			27.0	29.5	31.3	8.5	8.5	34	26.5
18	3.49±0.231	5.83±0.376	6.83±0.176	5.77±0.208			27.2	29.6	31.5	8.4	8.4	33	25.5
19	3.68±0.230	5.80±0.262	6.85±0.231	5.74±0.305			27.5	29.6	31.4	8.3	8.3	36	27
20	3.56±0.437	5.78±0.275	6.84±0.165	5.69±0.250	1.455	51.2	27.5	29.7	31.5	8.3	8.3	36	27.5
21	3.51±0.369	5.77±0.208	6.83±0.176	5.68±0.144			27.6	29.8	31.3	8.2	8.2	37	28
22	3.43±0.323	5.74±0.305	6.81±0.173	5.62±0.299			27.2	29.5	31.2	8.3	8.3	36.5	28
23	3.38±0.231	5.74±0.206	6.84±0.165	5.57±0.344			27.4	29.6	31.5	8.0	8.0	37	28
24	3.33±0.254	5.78±0.275	6.81±0.173	5.53±0.275			27.5	29.6	31.6	8.1	8.1	37	27.5
25	3.39±0.250	5.74±0.305	6.79±0.186	5.69±0.250			27.5	29.5	31.3	8.0	8.0	36	27
26	3.37±0.275	5.90±0.231	6.78±0.237	5.78±0.230			27.4	29.5	31.2	8.0	8.0	36	27
27	3.35±0.231	5.87±0.231	6.76±0.186	5.74±0.305			27.4	29.5	31.2	7.9	7.9	35	26.5
28	3.49±0.231	5.83±0.376	6.70±0.186	5.69±0.250			27.2	29.3	31.5	7.9	7.9	34.5	27
29	3.56±0.161	5.80±0.265	5.89±0.151	5.69±0.250			27.5	29.2	31.3	7.7	7.7	35	27
30	3.51±0.369	5.78±0.275	6.85±0.186	5.68±0.344	3.020	106.3	27.4	29.1	31.3	7.8	7.8	33	36.5
31	3.49±0.231	5.77±0.208	6.81±0.173	5.62±0.299			27.2	29.0	31.2	7.7	7.3	32.5	28
32	3.42±0.164	5.74±0.305	6.76±0.186	5.69±0.250			27.5	29.5	31.3	7.6	7.6	33	28.5
33	3.45±0.161	5.74±0.206	6.70±0.186	5.57±0.344			27.5	29.6	31.4	7.4	7.7	35	26.5
34	3.39±0.161	3.68±0.344	6.64±0.161	5.56±0.324			27.4	29.3	31.0	8.5	8.7	37	27.5
35	3.34±0.231	5.62±0.299	6.58±0.165	5.53±0.275			27.2	29.2	30.8	8.5	8.8	36	27
36	3.45±0.161	5.57±0.344	6.58±0.206	5.50±0.275			27.1	28.8	30.7	8.3	8.5	35	28
37	3.42±0.164	5.56±0.324	6.52±0.116	5.49±0.345			27.0	28.8	30.8	8.3	8.6	36	28
38	3.39±0.161	5.53±0.275	6.51±0.186	5.46±0.206	4.32	152.0	26.8	28.8	30.7	8.3	8.5	35	25.5
39	3.34±0.231	3.40±0.231	4.90±0.295	4.04±0.189			26.8	28.7	30.5	8.2	8.5	36	26.5
40	3.38±0.231	5.46±0.206	6.48±0.186	5.40±0.254			26.6	28.5	30.3	8.1	8.4	37	28
41	3.36±0.297	5.40±0.256	6.47±0.116	5.39±0.275			26.6	28.5	30.3	8.1	8.4	36	27
42	3.36±0.252	5.39±0.275	6.40±0.138	5.34±0.231	5.57	196.0	26.4	28.4	30.2	8.0	8.2	36	28
43	3.34±0.231	5.34±0.231	6.36±0.161	5.31±0.231			26.2	28.2	30.5	7.8	8.0	35	28.5
44	3.31±0.258	5.32±0.267	6.34±0.186	5.27±0.199			26.4	28.1	30.2	7.8	8.1	33.5	29
45	3.31±0.258	5.31±0.231	6.30±0.161	5.30±0.231			26.1	28.3	30.1	7.6	7.9	34.5	28.5
46	3.34±0.231	5.29±0.206	6.29±0.182	5.29±0.206	6.25	219.9	26.5	28.2	30.5	7.6	7.8	37	28
47	3.28±0.209	3.75±0.282	4.85±0.299	4.09±0.208			25.8	28.5	29.0	7.5	7.8	37	28.5
48	3.38±0.231	5.26±0.189	6.36±0.161	5.26±0.189			25.8	28.0	29.2	7.5	7.7	35	26.5
49	3.33±0.254	3.78±0.214	4.88±0.235	4.12±0.249			25.6	28.2	29.4	7.5	7.7	33.5	27
50	3.34±0.231	5.31±0.231	6.47±0.116	5.22±0.186	7.52	264.6	25.5	28.0	29.3	7.4	7.7	36	27.5
51	3.31±0.258	5.29±0.206	6.36±0.161	5.18±0.165			25.6	27.8	29.5	8.6	8.9	37	28
52	3.29±0.330	5.27±0.199	6.34±0.186	5.17±0.369			25.4	27.6	29.6	8.4	8.7	37	28.5
53	3.29±0.319	5.26±0.189	6.30±0.161	5.18±0.165			25.4	27.6	29.5	8.4	8.7	37	27
54	3.28±0.209	5.25±0.275	6.23±0.186	5.26±0.189	9.28	326.5	25.2	27.4	29.8	8.1	8.3	36	26.5
55	3.26±0.230	5.25±0.275	6.23±0.133	5.30±0.231			25.5	27.4	29.5	8.1	8.3	36	26.5
56	3.07±0.279	3.77±0.275	4.90±0.295	4.13±0.275			25.1	27.5	29.4	8.0	8.2	34	25.5
57	3.04±0.365	3.67±0.254	4.88±0.235	4.15±0.413			25.0	27.3	29.2	7.8	8.1	34	26
58	3.31±0.258	5.17±0.369	6.52±0.116	5.18±0.165	10.90	383.5	25.0	27.2	29.3	7.8	8.0	35	27
59	3.28±0.299	5.11±0.230	6.64±0.161	5.17±0.369			24.8	27.4	29.2	7.6	7.9	33	26.5
60	3.26±0.230	5.09±0.289	6.58±0.165	5.01±0.275			24.6	27.2	29.1	7.6	7.8	34	26.5
61	3.54±0.319	5.08±0.230	6.52±0.116	4.99±0.324			24.5	27.0	29.2	7.6	7.8	33	26.5
62	3.49±0.231	5.07±0.205	6.51±0.186	4.98±0.301	12.60	443.3	24.5	27.0	29.5	7.5	7.8	33	26.5
63	3.42±0.164	5.03±0.182	6.48±0.186	4.97±0.302			24.2	27.5	29.3	7.5	7.7	34	26
64	3.38±0.231	5.01±0.275	6.47±0.116	4.96±0.249			24.1	26.0	29.1	7.5	7.7	33	25.5
65	3.37±0.275	4.98±0.389	6.58±0.206	4.91±0.368			24.0	26.0	29.0	8.8	9.1	33	28.5
66	3.38±0.231	4.97±0.302	6.70±0.186	4.88±0.235	12.90	453.9	23.9	26.5	28.8	8.6	8.9	34	27.5
67	3.49±0.231	4.96±0.249	6.85±0.186	4.86±0.275			23.8	26.7	28.9	8.5	8.8	34	26.5
68	3.54±0.391	4.93±0.301	6.83±0.165	4.84±0.398			23.7	26.7	28.8	8.5	8.7	33.5	27
69	3.37±0.275	4.91±0.368	6.81±0.161	4.86±0.231			23.6	26.3	28.7	8.4	8.7	34	26.5
70	3.42±0.164	4.90±0.295	6.79±0.186	4.83±0.275	13.83	486.6	23.5	25.8	28.5	8.2	8.5	35	26.5
71	3.39±0.161	4.88±0.235	6.76±0.186	4.85±0.299			23.6	25.9	28.2	8.2	8.4	33	25.5
72	3.26±0.230	3.37±0.275	4.88±0.235	3.96±0.257			23.5	25.7	28.0	8.2	8.4	34.5	27
73	3.75±0.282	4.85±0.299	6.76±0.186	4.72±0.186			23.4	25.6	28.0	8.0	8.3	33	26.5
74	3.51±0.369	4.83±0.275	6.78±0.257	4.68±0.259	14.90	524.3	23.2	25.5	27.9	8.0	8.2	35	37
75	3.78±0.214	4.80±0.275	6.79±0.186	4.64±0.231			23.0	25.4	27.7	7.8	8.0	35	28
76	3.72±0.275	4.77±0.279	6.78±0.257	4.59±0.301			23.0	25.5	27.5	7.8	8.1	36	28
77	3.67±0.254	4.75±0.369	6.76±0.186	4.58±0.368			23.2	25.7	27.6	7.8	8.0	36	28
78	3.60±0.283	4.73±0.295	6.70±0.186	4.56±0.324	16.39	576.7	23.4	25.5	27.5	7.6	7.9	37	27
79	3.56±0.437	4.61±0.275	6.69±0.165	4.43±0.275			23.2	25.2	27.2	7.6	7.8	37	28

80	3.51±0.369	4.58±0.368	6.64±0.161	4.37±0.256			23.5	25.5	27.4	7.5	7.7	37	27
81	3.54±0.319	4.55±0.324	6.81±0.173	4.30±0.235			23.2	25.6	27.2	7.5	7.8	37.5	28
82	3.49±0.231	4.50±0.231	6.79±0.186	4.29±0.249	17.87	628.8	23.0	25.5	27.0	8.4	8.7	34	26
83	3.38±0.231	4.40±0.242	6.64±0.161	4.68±0.259			23.3	25.4	27.2	8.3	8.6	33.5	26.5
84	3.37±0.275	4.36±0.320	6.79±0.186	4.64±0.231			23.0	25.0	27.5	8.3	8.5	33.5	26.5
85	3.33±0.254	4.33±0.320	6.70±0.186	4.61±0.275			23.2	25.1	27.0	8.1	8.4	34	27
86	3.28±0.209	4.32±0.231	6.64±0.161	4.58±0.368	20.00	703.7	22.8	24.8	26.9	8.1	8.3	35	27
87	3.07±0.279	3.54±0.369	4.88±0.235	3.78±0.214			22.7	24.6	26.8	8.0	8.2	35	27
88	3.04±0.317	3.49±0.231	4.84±0.398	3.72±0.250			22.9	24.9	26.7	7.8	8.0	36.5	26.5
89	3.04±0.365	4.15±0.423	6.52±0.106	4.40±0.242			22.8	24.8	26.8	7.8	8.1	37	27
90	2.98±0.319	4.13±0.275	6.52±0.161	4.37±0.256	21.84	769.4	22.6	24.5	26.7	7.8	8.0	37	27.5
91	2.96±0.334	4.12±0.249	6.64±0.161	4.36±0.320			22.5	24.5	26.7	7.6	7.8	37	27
92	2.76±0.366	4.04±0.189	6.58±0.206	4.33±0.320			22.5	24.6	26.8	7.6	7.9	36	26.5
93	2.86±0.345	4.09±0.208	6.69±0.165	4.32±0.231			22.3	24.5	26.5	7.6	7.9	36	26.5
94	2.61±0.161	3.07±0.167	4.91±0.368	3.76±0.413	23.68	833.2	22.1	24.4	26.5	7.5	7.8	36.5	27
95	2.50±0.171	3.19±0.389	4.86±0.275	3.72±0.250			22.0	24.5	26.3	7.5	7.7	36	27.5
96	2.69±0.301	3.89±0.257	6.76±0.186	4.22±0.231			22.0	24.3	26.2	7.5	7.7	36	28
97	2.55±0.299	3.96±0.257	6.70±0.186	4.29±0.249			21.9	24.2	26.1	7.4	7.6	35	27
98	2.54±0.320	3.96±0.257	6.69±0.165	4.17±0.393	26.28	924.7	21.7	24.0	26.0	7.4	7.6	34	26.5
99	2.49±0.344	3.94±0.231	6.70±0.186	4.33±0.320			21.6	23.9	26.0	8.8	9.1	33	28
100	2.44±0.299	3.89±0.344	6.64±0.161	4.36±0.320			21.5	23.7	25.8	8.6	8.9	33.5	27
101	2.44±0.161	3.77±0.275	6.58±0.206	4.43±0.275			21.5	23.6	25.9	8.6	8.8	34	26.5
102	2.38±0.295	3.75±0.282	6.52±0.161	4.50±0.275	29.64	1042.9	21.4	23.5	25.7	8.4	8.7	34	27
103	2.35±0.346	3.56±0.437	6.48±0.186	4.34±0.295			21.5	23.7	27.8	8.4	8.6	34	27
104	2.32±0.161	3.51±0.166	6.47±0.166	4.33±0.221			21.2	23.5	25.5	8.4	8.6	35	27.5
105	2.38±0.165	3.45±0.161	6.40±0.138	4.32±0.275			21.2	23.3	25.4	8.2	8.5	35	28
106	2.16±0.161	2.32±0.161	4.86±0.275	3.38±0.321	32.15	1131.20	21	23.0	25.2	8.2	8.4	35	27
107	2.11±0.275	2.24±0.297	4.83±0.275	3.33±0.254			21	23.5	25.1	8.0	8.3	36	27.5
108	2.10±0.394	2.17±0.324	4.80±0.275	3.28±0.230			21.5	23.5	25.0	8.1	8.2	36	27.5
109	2.08±0.183	2.16±0.161	4.75±0.369	3.26±0.230			21.4	23.3	25.2	7.9	8.2	37	27
110	2.56±0.161	3.60±0.138	6.29±0.182	4.24±0.186	34.40	1210.4	21.3	23.2	25.1	7.9	8.1	37	28
111	2.11±0.275	2.24±0.297	4.77±0.279	3.19±0.389			21.2	23.0	25.3	7.6	7.9	36.5	27
112	2.08±0.183	2.17±0.324	4.73±0.295	3.10±0.367			21	23.2	25.5	7.6	7.8	37	27
113	2.20±0.138	3.45±0.161	6.20±0.186	4.21±0.279			21.5	23.5	25.2	7.6	7.8	37	27.5
114	2.16±0.161	3.82±0.142	6.19±0.161	4.12±0.209	35.25	1240.3	20.8	23.6	24.8	7.5	7.8	37.5	27
115	2.64±0.123	3.35±0.142	5.99±0.212	3.99±0.257			20.8	23.5	24.6	7.5	7.7	37	27
116	2.55±0.209	2.76±0.366	4.80±0.275	3.26±0.230			20.5	23.5	24.5	7.5	7.7	37	27
117	2.61±0.161	3.21±0.460	5.95±0.137	3.65±0.141			20.6	23.3	24.2	7.4	7.6	37.5	28
118	2.58±0.189	3.39±0.319	5.97±0.161	3.71±0.138	36.11	1270.5	20.4	23.5	24.5	8.7	8.9	34	28
119	2.56±0.161	3.19±0.389	5.93±0.231	3.99±0.560			20.8	23.2	24.7	8.5	8.7	33	28
120	2.48±0.186	3.18±0.319	5.89±0.231	3.89±0.254			20.7	22.9	24.5	8.5	8.8	34	27
121	2.61±0.161	3.21±0.460	5.87±0.231	3.71±0.138			20.5	22.8	24.3	8.3	8.5	33.5	26.5
122	2.50±0.171	3.61±0.161	5.85±0.254	3.65±0.141	37.05	1303.6	20.2	22.5	24.2	8.3	8.6	34	27
123	2.11±0.275	2.17±0.324	4.75±0.369	3.10±0.367			20.1	22.6	24.0	8.0	8.3	35	26.5
124	2.08±0.183	2.24±0.297	4.73±0.295	3.02±0.301			20.4	22.5	24.0	8.0	8.2	35	26.5
125	2.24±0.297	3.38±0.142	5.78±0.230	3.37±0.367			20.5	22.8	24.2	7.8	8.1	36	27
126	2.17±0.324	3.35±0.142	5.77±0.208	3.24±0.320	38.67	1360.6	20.0	22.5	24.0	7.8	8.0	36	27
127	2.16±0.250	3.26±0.187	5.78±0.275	3.10±0.367			19.8	22.0	23.8	7.6	7.9	37	27.5
128	2.11±0.275	3.07±0.167	5.80±0.262	,3.02±0.301			19.9	22.5	23.6	7.6	7.9	37	27.5
129	2.20±0.133	3.29±0.319	5.87±0.231	3.19±0.389			19.8	22.5	23.5	7.5	7.7	37.5	27
130	2.16±0.256	3.19±0.389	5.89±0.231	3.18±0.319	40.3	1418	19.7	22.4	23.5	7.5	7.8	37	28

Table 2: One-way ANOVA of Temperature, pH, and Transparency/Turbidity to the Total Culture Period at 0.05 Significant Level

Days	F- Ratio Value		*p*-Value		*p* <0.05	
	Temperature 0^{C}		pH		Transparency/ Turbidity. cms	
	6.00 AM	6.00 PM	6.00 AM	6.00 PM	6.00 AM	6.00 PM
1-30	9329.399	3530.454	<0.00001	<0.00001	significant	significant
31-60	5961.770	16221.632	<0.00001	<0.00001	significant	significant
61-90	6087.589	2298.069	<0.00001	<0.00001	significant	Significant
91-120	6479.149	8532.339	<0.00001	<0.00001	significant	significant
121-130	2831.275	7302.391	<0.00001	<0.00001	significant	Significant



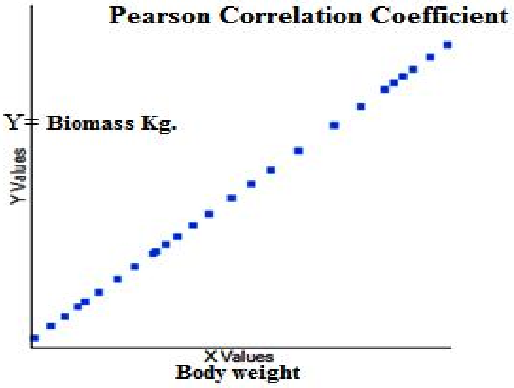


Figure 2 & Figure 3

DISCUSSIONS

Even-though information exists on oxygen requirements of several other species of crustaceans, work relating to the oxygen variations and metabolic rates of *P. monodon* under various conditions of aquaculture practices is negligible. The dissolved oxygen were maintained by water exchange, turbidity, pH and water temperature (Rama Rao, 1996). The similar studies were observed in various culture ponds with different stocking densities. Madeniian (2008) was studied on dissolved oxygen concentration and water temperature were monitored in four marine shrimp, *Penaeus vannamei* and *P. monodon*, Pond production and respiration were estimated based on DO curves. Trend analysis revealed a significant decline in pond net production during grow-out. Mohanty, (2001) studied at different stocking densities of *Penaeus monodon*. Four different aeration patterns were adopted and evaluated. Influence of individual aeration pattern on average survival rate was not highly significant($p<0.05$) at different stocking densities, while different aeration patterns had significant influence ($p<0.00$) on survival rate of *P. monodon.* Fast, et al (1998) investigated at, differences in average whole pond respiration were pronounced, with the deepest ponds the diurnal temperatures in deep ponds fluctuated on average 1.7^{O}C less than in shallow ponds. *Penaeus vannamei* and Penaeus monodon grown at different dissolved oxygen levels. Janakiram, et al.,.(2011), represented of survival, growth and production of *Penaeus monodon* in modified- extensive and Semi Intensive Culture Systems. Apud et al., (1980), Chakraborti (2002), Anil, Kotiya et al., (2011).

CONCLUSIONS

Variations were more significant especially when the shrimps have grown more than 30 gm in their body weight. The shrimps were usually active during the night time (nocturnal) and oxygen consumption was more. In addition to this, normal metabolic activity as revealed by schooling behaviour of the shrimps was observed at night time. The shrimps used to moult more during the night time demanding greater quantities of oxygen. This particular phenomenon is very significant and related to lunar periodicities. The other competitor for dissolved oxygen during the night time is the phytoplankton. The reason for increased dissolved oxygen levels during the day time reflects on phytoplankton, which during the photosynthetic activity produces more oxygen and during the night time the phytoplankton also consumes oxygen along with the During the cloudy day, shrimps for respiratory activity, the day time oxygen levels were relatively less as indicated.

REFERENCES

1. *Anil, Kotiya S; Balakrishanan, Gunalan; Kanji, Jetani L; Jitesh, Solanki B; Kumaran, Ramchandran.. Comparison of Penaeus monodon (Crustacea, Penaeidae) growth between commercial feed vs commercial shrimp feed supplemented with Kappaphycus alvarezii (Rhodophyta, Solieriaceae) seaweed sap., Aquaculture, Aquarium, Conservation & Legislation; Cluj-Napoca Vol. 4, Iss. 3, (Jul 2011): 292-300.*
2. *Apud, F. D., Gonzales, K., & Deatras, N. (1980). Survival, growth and production of Penaeus monodon at different stocking densities in earthen ponds with flow-through system and supplementary feeding. SEAFDEC Aquaculture Department Quarterly Research Report, 4(4), 15-18.*
3. *Chakraborti R.K, J.K. Sundaray and T.K. Ghoshal Production of Penaeus monodon in the tide fed ponds of Sunderbans. Indian J. Fish., 49(4) : 419-426,, 2002.*
4. *Fast. AW, KE Carpenter, VJ Estilo, HJ Gonzales* ***1998.*** *Effects of water depth and artificial mixing on dynamics of Philippines brackishwater shrimp ponds,- Aquacultural engineering, Volume 7, Issue 5, 1988, Pages 349-361.*
5. *https://goodcalculators.com/one-way-anova-calculator/*
6. *Janakiram, P, L. Jayasree, and R. Madhavi. 2011. Survival, Growth and Production of Penaeus monodon in Modified- Extensive and Semi Intensive Culture Systems of Andhra Pradesh, India. Asian J. Exp. Sci., Vol. 25, No. 2, 2011; 53-61.*
7. *Madeniian, C. P. 2008. Patterns of oxygen production and consumption in intensively managed marine shrimp ponds. Aquaculture Research 21(4):407 – 417.*
8. *Montgomery HAC, Thom NS, Cockburn A (1964). Determination of dissolved oxygen by the winkler method and the solubility of oxygen in pure water and sea water. Vol. 14, Issue 7, 280-296*
9. *Mohanty, R. K. 2001. Effect of pond aeration on growth and survival of Penaeus monodon Fab. Bangladesh Journal of Fisheries Research, Vol 5, Issue 1, 59-65.*
10. *Rama Rao. K. 1996. Studies on feeding behavior, oxygen requirements and growth of larval & adult Penaeus monodn (Fabricius 1798) (Crustacea Decapoda). Ph. D thesis, Andhra University. 1 – 216.*